Retrospect

VITAMINS*

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The complexity of the component factors in our existence is steadily being revealed. Our daily bread is one such factor: until of late years we have looked upon it as something regarding which we had an almost instinctive knowledge, and it is somewhat in the nature of a disillusionment to find that this instinct is not infallible. It did not serve, for example, to keep the coolie from eating milled rice, nor even hint to him that from thence arose his beri-beri. So that the history of our interest in vitamins is to some extent bound up with the developments in modern treatment of food whereby the appearance or taste has been altered at the expense (unknowingly) of its nutritive value.

We have long looked upon food as consisting of four fundamentals, protein, carbohydrate, fat, and inorganic material; but whenever it has been attempted to combine these units to form a diet sufficient for growth or life, failure has resulted. This was noted as early as 1881 by Lunin. He was investigating the place of inorganic salts in nutrition, and he found that whilst mice could live for months on a diet of milk, they soon died if fed on a diet composed of what he believed to make up the milk, *i.e.*, caseinogen, fat, lactose, and salts. He therefore concluded that there must be other indispensable substances in the milk. Some thought, in explanation of the failure of such diets, that it was due to the monotony of the food; but milk diet, of equal monotony, succeeded where the other failed. Nor was it because these diets lacked flavour, for the addition of suitable flavouring did not alter matters. Whenever anyone apparently succeeded in satisfying the nutritive requirements of animals by isolated and purified food components, close analysis showed some fault in the technique of the experiments.

Then experiments began to be made which showed that if even quite insignificant amounts of milk, for example, were added to such artificial diets, normal and continual growth was attained. These experiments were first carried out by Hopkins in England, in 1906, and his conclusions carried him to a stage beyond which we have not greatly advanced in the last 18 years. He "realized that what is absent from artificial diets and supplied by such addenda as milk and tissue extracts is of the nature of an organic complex (or complexes) which the animal body cannot synthesize. But the amount which seems sufficient to secure growth is so small that a catalytic or stimulative function seems more likely." These substances he termed "accessory factors of the diet." They were not recognized in current views on nutrition, but neither was it fully recognized even then that animals might receive all the formative matter and energy sufficient for growth, and still might not grow.

The next step in defining these accessory food factors was the discovery that they were quite certainly of more than one kind, and in 1915 McCollum and Davis summed up the situation as follows: "There are necessary for normal nutrition during growth two classes of unknown accessory substances, one soluble in fats and accompanying them in the process of isolation from certain food-stuffs, and the other soluble in water but apparently not in fats." They called these substances "fat-soluble A" and "water-soluble B," in preference to Funk's term "vitamine," which was open to certain criticisms. But language, even in science, is not so easily wrought to our desires, and the terms "vitamin A" and "vitamin B" have gradually come to be used. The omission of the terminal "e" is in accordance with the system by which it is desired to show that the substances in question are not definitely known to be bases.

Growth and nutrition of the animal organism, then, depends beyond all doubt, on the presence of two distinct substances in the food, one of these being soluble in fat and the other in water. But a third accessory factor is to be added, and this is the antiscorbutic factor, vitamin C. It is quite certain that this factor is indispensable for the nutrition of certain species of animals, but in our present state of knowledge we cannot say that it plays such a generally indispensable part as do the other two substances.

We know that vitamins are chemical entities, but we are still ignorant of their exact chemical

*The Medical Research Council's Report on the Present State of Knowledge of Accessory Food Factors (Vitamins). H.M. Stationery Office, London, 1924. 4s. 6d.

nature. We are sure only of the existence of three, but recent discoveries suggest that these do not exhaust the list. As to the quantity contained in food it is not one of their least striking features that they manifest a degree of activity which is highly disproportionate to the minute amounts occurring in a normal diet. This peculiarity it is which marks them off from the foodstuffs, and suggests their action to be that of a catalytic agent. There is evidence to suggest that they are formed largely, but not entirely, in the tissues of plants, whence they pass into the tissues of herbivorous animals and become available for carnivora: they cannot be synthesized in the animal. While they may be distributed in plant or animal tissues in a partial and irregular manner, it is safe to say, speaking broadly, that our food will have sufficient vitamins if it is reasonably varied, has not been artificially separated into parts, and has had no destructive influence applied to it.

Vitamin A.—The actual extent to which vitamin A is concerned in the nutrition of the body is only partially understood. There is every reason to believe that much of it may be stored in the body, perhaps in association with the reserve fat supplies, a point of extreme importance in the case of the pregnant or nursing mother.

The richest source of supply is quite unquestionably the liver of the cod and many other fish, and here as in the case of mammals, the vitamin is built up from the vegetable kingdom. It has been shown that marine algae can synthesize very high concentrations of the vitamin, if grown in sterilized sea water, in the light: these algae are devoured by the smaller forms of marine life which are the food of larger types, which in turn are eaten by the cod, etc.

It is soluble in fat solvents, *e.g.*, ether and alcohol. Heat alone does not greatly affect it, unless there is exposure to air or oxygen at the same time, in which case rapid destruction takes place. Ozone alone will produce the same effect. Hence, certain fish oils prepared under steam at high pressure, may yet retain a great deal of the vitamin. It is to be noted that the more darkly coloured cod liver oils do *not* contain more of this factor than the colourless oils. One substance at least whose vitamin content is seriously affected by the method of preparation is lard. The fat of the pig can be shown to contain it, but the refining process inactivates it.

As regards isolation, it has been found that if fat is saponified—in absence of air—there is a residue; this contains cholesterol and certain bases, and with the removal of these the remaining fraction is found to have the properties of the vitamin. Certain colour tests are also of some value in demonstrating its presence. A purple colour will be given by dissolving codliver oil in an organic solvent and adding sulphuric acid, and this reaction occurs in a great many oils and fats which are known to contain vitamin A. The reaction disappears, however, if the fat be heated in the presence of air, but remains if heated without air. Such facts are at least significant. On the other hand, the reaction does not take place with the marine diatom and plankton oil, in which, as has been stated, rich supplies of the vitamin are known to exist.

Vitamin B:—The chief sources are the seeds of plants, *e.g.*, cereals and edible pulses, yeast, and eggs of birds. It is now well established that, as a rule, amongst the cereals, the factor is chiefly concentrated in the embryo or germ; next in importance of content is the bran (pericarp) or envelope. It apparently exists free in the plant cell. We do not know under what conditions the synthesis is carried out. On the whole there does not appear to be a reserve store in the body.

Considerable uncertainty exists as to the vitamin B content of milk; the diet of the cow is a factor of considerable importance. But it is at least certain that the various forms of condensed and dried milk contain as much of the vitamin as may be in the fresh milk. The processes of preparation in this case do not cause deterioration. Yeast is rich in vitamin B, and is not affected by autolysis or extraction.

This factor withstands desiccation for long periods, as may be appreciated from the fact that it is found so largely in dried foodstuffs. It also withstands heat very well up to 100° C., but deteriorates rapidly at 120° C. In the baking of bread, therefore, there is no great loss of the vitamin. In preserving and canning, however, the temperatures employed are usually well above 100° C., and foods so treated should therefore be regarded as containing none of this vitamin. It does not seem to be affected by oxidation, nor by ozone or ultraviolet light. It resists hydrolysis and acids; is dialyzable, and passes through collodion membranes which are permeable to semicolloidal substances. It is soluble in water, and can be extracted with alcohol.

Much work is still necessary to clearly make out its effects on the secretory power of glands, its relation to other food constituents, as well as to the growth of fungi, yeasts, the higher plants, and bacteria. Investigations are being carried on which indicate that the functions dependent on this factor are of wide extent, although at present our attention is most closely concentrated on its anti-neuritic function.

Vitamin C.—(Antiscorbutic Vitamin): In general, this is found in living tissues in which metabolism is taking place, such as fresh vegetables and fruit. The cabbage leaf is one of the richest sources, as is also the juice of raw swede turnips. Amongst the fruits the orange and lemon are the most valuable anti-scorbutics. There is a marked difference in the vitamin content of lemon and lime juice, the latter being distinctly inferior; if of the preserved kind it is almost quite devoid of the factor. Preserved lemon juice is more satisfactory. Oranges and lemons if kept in the cold will retain their potency for six months. Tablets can be prepared from their juices which retain the anti-scorbutic properties completely.

Tomatoes are rich in the factor. Milk contains it in very variable quantities. Meat contains but little, and its well attested capacities as an anti-scorbutic seem to depend on large quantities being eaten. Patients have developed scurvy even when meat was included in their diet.

As with vitamin A, heat is detrimental, in the presence of oxygen, and it is also to be noted that temperatures from 80° to 100° C. cause great deterioration, a fact to be borne in mind in estimating the anti-scorbutic value of cooked vegetables. The canning of vegetables causes great loss of potency, but not so much in the case of tomatoes, unless these have been exposed to the air in the process, as in making of puree. Drying causes almost complete loss of the factor, but fruit juices will not be so much affected if evaporated *in vacuo*.

It is not often that we receive publications so admirable in every respect as the Medical Research Council Report on which the foregoing remarks are based. It contains material of very great value to medical men, and brings up to date in a very clear manner knowledge which has not yet been so made available to the general practitioner.

Ménière's Syndrome Caused by Allergy.—W. Duke, Kansas City, Mo., has observed Ménière's syndrome in two patients with severe allergy in whom no other adequate cause for the illness was found. Since, in each case, relief was obtained both by the use of epinephrin and by the avoidance of substances to which the patients were sensitive, and since the symptoms were reproduced during well periods by the use of foods to which they were hypersensitive, it seemed justifiable to Duke to include allergy among the primary causes of the symptom complex known as Ménière's syndrome.—*Jour. Am. Med. Ass.*, Dec. 29, 1923.

The Lens as seen with the Gullstrand Slit Lamp and Corneal Microscope.—By carefully considering the facts presented, Arthur J. Bedell, Albany, N.Y., asserts that it is possible to observe embryologic, physiologic and pathologic lens changes. It is essential that the technic of examination be mastered and that the changes noted be given their proper value. The visualization of cataract formation is so real that, although heretofore the lens has been the most difficult part of the eye to study pathologically, it is now comparatively easy. To see a cataract develop in a recent detachment of retina proved a most instructive experience, for first there was a faint posterior cortical haze which increased in density and surface involvement, and then the anterior cortex showed many oil globules and fan-shaped opacities. Finally, the entire lens was milky white. The economic importance of lens capacity is so great that any aid in the elucidation of cause must have an influence of wide range. The slit lamp makes it possible to study lens changes so completely that it may safely be said that, within the next ten years, the therapeutic sphere will be greatly enlarged—*Jour. Am. Med. Ass.*, Feb. 2, 1924.